DETAILED ACTION

Status of Claims

Claims 1-15 and 19-24 are pending based on the claims as presented in the communication of 3/28/2011.

Claims 3, 5-7 and 19-24 are allowed.

Based on applicant's newly submitted IDS, claims 1, 2, 4 and 8-15 are rejected based on the disclosed prior art Dreifus et al., JP 4312982, also published in English as US 5,173,761.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 6/29/11 has been entered.

Response to Amendment

2. All communications below are in reference to the claims as presented in the communication of 3/28/11. On 6/29/11 applicant submitted an IDS. The following was noted concerning this IDS:

The IDS dated 6/29/11 included:

- JP4312982 (also published in English as Dreifus et al. US 5,173,761) teach a semiconductor device formed of a silicon layer and a doped and undoped diamond layer. Dreifus et al. does note teach recessed areas of non-conducting diamond in relation to the conducting regions as required by claim 3; however, *Dreifus et al. does teach areas of conducting and non-conducting diamond creating planar surfaces with each other as recited in claim 1 and a rejection is set forth below.*
- The abstract of JP2005005659 teach a diamond-laminated substrate having the conducting diamond on top of the non-conducting diamond which is opposite from that claimed by applicant.
- The abstract of JP5018935 teach a diamond thin film ion sensor having an insulating diamond layer (figure 1; 2/5) both below and over a conducting diamond layer (3/4). The conducting diamond layer does not extend through the non-conducting layer, nor does it form wells.
- The abstract of JP8240555 (also published in English as US 5,777,372) teach a transducer having an undoped diamond substrate having electrodes on its surface which are covered with a semiconductor

diamond heater. In this case the doped diamond does not create planar areas in relation to the undoped areas.

- WO2004/005585 A1 (also published in English as US 7,455,754 B2) teach a diamond electrode which comprises a metal substrate layer comprising embedded doped diamond particles. With regard to the doped diamond particles embedded in the metal layer, even if there were a passivation layer (i.e. non-conducting) on the exposed metal, the doped diamond would not extend to the planar surface of the passivation layer, nor would it form a well or reservoir since the doped diamond would extend beyond the passivation layer (see figure 1).
- The abstract of JP2002286692 (see examiner provided machine translation) teach a field-effect transistor having a channel between the electrodes (one gold and one Ag/AgCl) composed of an exposed diamond surface. This device does not contain an un-doped diamond layer through which a doped diamond layer extends.
- JP2003121410 (see examiner provided machine translation) teach a diamond electrode that consists of a conductive diamond membrane 13 formed on the base material 12 with iridium particles 14 placed on the diamond membrane 13. A lead 16 is connected from the front-side of the diamond membrane (figure 1). This device does not teach a contact surface on the back side of the conducting diamond for external connection, not does this application teach a non-conducting (i.e.

undoped) diamond layer from which the conducting layer would present planar or recessed planar areas.

Allowable Subject Matter

Claims 3, 5-7 and 19-24 are allowed.

3. The following is an examiner's statement of reasons for allowance for claims 3, 5-7 and 19-24:

The instant application is allowable over the prior art because the instant application teaches a microelectrode comprising an electrically conducting diamond layer with a non-conducting diamond layer on the electrically conducting layer, wherein one or more areas of electrically conducting diamond presents *planar areas* that extend through the non-conducting diamond. The *planar areas* of the conducting diamond extend to the surface (i.e. coplanar with) of the non-conducting layer creating pins or projections OR the *planar areas* of the conducting diamond are recessed relative with the surface of the non-conducting diamond layer creating a well or reservoir.

The additional prior art of record, JP4312982 (also published in English as Dreifus et al. US 5,173,761) teach a semiconductor device formed of a silicon layer and a doped and undoped diamond layer. Dreifus et al. does note teach recessed areas of non-conducting diamond in relation to the conducting regions as required by claim 3.

Claim Objections

4. Claims 2, 13 and 14 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 2 recites that the pins or projections extend to a surface of the non-conducting diamond layer presenting one or more areas of electrically conducting diamond co-planar with the non-conducting surface. However, claim 1, from which claim 2 depends, already recites that the pins or projections extend to the planar surface of the non-conducting diamond layer. Thus, claims 2 fails to further limit claim 1, since claim 1 contains the limitation of claim 2. Since claims 13 and 14 depend from claim 2, they are also objected too.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1, 2, 8-12 and 15 are rejected under U.S.C. 102(b) as being anticipated by Dreifus et al. (US 5,173,761, recited on applicant's IDS dated 6/29/11 as JP 4312982 English Abstract, US 5,173,761 is the English equivalent).

Regarding claims 1 and 2, Dreifus et al. teach a semiconducting apparatus that utilizes (see figures 1 and 4; cols 3-6):

- an electrically conducting diamond layer 25/50 (i.e. boron doped diamond 25/50);
- a non-conducting diamond layer 30 (i.e. un-doped) presenting a co-planar surface with the conducting diamond layer 50;
- one or more pins or projections of electrically conducting diamond 50 extending at least partially through the non-conducting diamond layer 30 wherein the pins or projections 50 present planar areas of electrically conducting diamond;
- the pins or projections 50 extend to the planar surface of the non-conducting 30 layer (i.e. co-planar); and
- a contact surface or surfaces on the back side of the electrically conducting diamond layer 25 for connection to an external circuit. For example, the back side surface of layer 25 that is against the silicon substrate; the back side surface of the silicon substrate located against the Ag Paste 35; or the back side of the Ag Paste 35 all read on a back side surface that provides for a contact surface that is connectable to an external circuit.

It is noted that the preamble of the present claim recites “a microelectrode;” however, it is noted that this is a recitation of the intended use of the device and a recitation of the intended use of the claimed invention must result in a structural

difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See In re Casey, 152 USPQ 235 (CCPA 1967) and In re Otto, 136 USPQ 458,459 (CCPA 1963). In the present case, Dreifus et al. teach a semiconducting device that is capable of conducting and thus performing the function of a microelectrode (see col. 6, lines 65-68). Additionally, claims must be structurally distinguishable form the prior art in terms of structure, not function. The manner of operating an apparatus does not differentiate and apparatus claim from the prior art, if the prior art apparatus teaches all of the structural limitations of the claims (see MPEP 2114).

Lastly, with regard to the sizing, i.e. “micro”, Dreifus et al. teach that the silicon substrate can have deposited thereon a film of insulating polycrystalline diamond 20 which is at least 20 microns thick; a second conducting diamond layer 25 being 1-2 microns; an undoped layer 30 that is deposited for 15, 30 or 60 minute intervals at a growth rate of 0.2 microns per hour which would equate to a maximum of 0.2 micron undoped layer 30; thus, in total that layers would amount to approximately 22.2 microns which would fall into a "micro" sized device (see col. 3). Also, it is noted that Dreifus et al. figure 4b does not require the insulating polycrystalline diamond layer 20 which is at least 20 microns thick; and thus would require only layers 25 and 30 which would total 2.2 microns thick.

Regarding claim 8, Dreifus et al. teach a ohmic contacts 50 that have the purpose of connecting the electrode structure which will be metalized later with the buried doped layer 25. Thus, Dreifus et al. teach areas of electrically conducting diamond 50 that are in electrical connection with a surface of the electrically conducting diamond layer 25. Additionally, one could read this claim as the aluminum layers (figure 5a) function as gate electrodes placed on the conducting and non-conducting diamond layer and these would be surfaces through which the conducting diamond layer 25 is connected. Lastly, Dreifus et al. teach that the areas of conducting diamond are internally connected within the diamond layer by the backside surface of the conducting diamond layer 25 which is connected to an Ag electrode which would place areas of the electrically conducting diamond layer 25/50 in electrical connection with a surface of the electrically conducting diamond layer (see figure 4; col. 5, lines 1-25).

Regarding claim 9, application's specification at 0014 states that, "the contact surface of the diamond could be coated with one or more layers of conductive material, optionally in combination with one or more non-conductive layers, to provide `on board` interconnection." Dreifus et al. (figures 2 or 5) teach that there are gate electrodes or aluminum layers, which are conductive, in contact with a nonconductive layer 30 which would provide the interconnection of the electrically conducing diamond layer.

Regarding claim 10, Dreifus et al. teach that the semiconductor device can have gate electrodes or silver or aluminum, metal, layers (see figure 2). An electric field that

the substrate is exposed to in certain embodiments may be created by any suitable technique, for example, by electrodes that are externally connected to the substrate, through metal portions of the substrate. Therefore, areas of the electrically conducting diamond are externally electrically connected into an electrode. The metal layers in Dreifus et al. would be externally connected to the conducting diamond layer 25 because the metal layers are first connected to the substrate and not directly connected to the conducting diamond.

Regarding claims 11 and 12, Dreifus et al. teach the use of a polycrystalline diamond (col. 6, lines 60-68).

Regarding claim 15, Dreifus et al. teach that the conducting diamond is boron-doped (col. 6, lines 60-68).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 4, 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dreifus et al. (US 5,173,761), as applied to claim 1 above.

Regarding claim 4, Dreifus et al. teach a semiconducting device having areas of conducting and non-conducting diamond as expressed above in claim 1; however, Dreifus et al. does not specifically teach that the conducting diamond areas are circular.

However, the court held that the mere change in shape is not patentable and is a matter of choice which a person of ordinary skill in the art would have found obvious

absent persuasive evidence that the particular configuration of the claimed container was significant. See In re Dailey, 357 F.2d 669, 149 USPQ 47 (CCPA 1966); MPEP 2144.04 IV B. Therefore, it would have been obvious to one skilled in the art to select a size and shape for the conducting diamond surfaces appropriate for the device.

Regarding claims 13 and 14, Dreifus et al. teach co-planar diamond surfaces as noted above in claim 1. Dreifus et al. also each that the conducting surfaces can be formed using a series of implants or by surface modification such as plasma etching. Additionally, Dreifus et al. teach the use of polishing to reduce surface roughness to make the device more uniform in terms of its electrical field distribution (col. 5-6).

While Dreifus et al. does not specifically teach that the surfaces have a roughness of less than 100 nmRa, since Dreifus et al. teach that the areas of electrically conducting diamond and co-planer surface and polished, if the surfaces are smooth, they are not rough and therefore would have a surface roughness of less than 100nmRa.

It is noted that "[I]n considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom." In re Preda, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968); MPEP 2144.04. Additionally, generally, differences in concentration or temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. "[W]here the general conditions of a claim are

disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Therefore, absent unexpected results showing the criticality, it would have been obvious to one skilled in the art that polishing surfaces; utilizing implementation; or etching to modify the surface of the conducting diamond would create a smooth surface and a roughness that would have some non-vanishing amount of surface that has a roughness of less than 100 nmRa in order to optimize the semiconductor performance as Dreifus et al. notes that polishing is important to reduce roughness especially when gate widths are 1 micron or less to help create uniform electric fields (see col. 6, lines 30-40).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JENNIFER DIETERLE whose telephone number is (571)270-7872. The examiner can normally be reached on Monday thru Thursday, 9am to 4pm (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jeffrey Barton can be reached on (571) 272-1307. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JMD
8/22/11

/Jeffrey T Barton/
Supervisory Patent Examiner, Art Unit 1759
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